

# Lightweight Robotic Excavation, Phase I

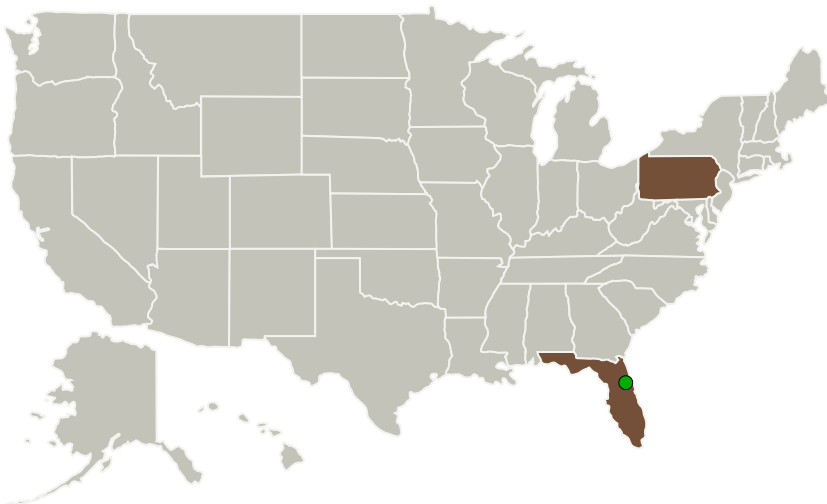
Completed Technology Project (2010 - 2010)



## Project Introduction

Robust, lightweight, power-efficient excavation robots are mission enablers for lunar outposts and surface systems. Lunar excavators of this type cost-effectively utilize native materials for both outpost preparation and in-situ resource utilization. They address the need for implements that dig, collect, transport, and dump lunar soil. Past prototypes, while providing valuable insights, have either been too large, too slow, or had too little pound-for-pound regolith moving capacity (payload ratio) to be real options for a lunar outpost. Novel designs incorporating dump beds, high-speed driving, and composite materials are game changers, making lightweight excavation robots advantageous for lunar site and surface work. Performance of elemental actions such as digging or driving has been studied, but it is performance in achieving a site-level task like berm building that matters. This proposal team has identified payload ratio and driving speed as dominating parameters governing site work. This has been done by creating and applying a task-level simulator, REMOTE (Regolith Excavation, Mobility & Tooling Environment), for a prior NASA contract. Current excavation force models do not adequately address cohesion and soil-tool friction within a lunar-relevant regime, as this work proposes to do. Trade studies and prototypes of lunar excavators are informative, but direct controlled comparisons of configuration options (ex. loader or dozer) will yield the best means of choosing a real design. The Technology Readiness Level (TRL) at the beginning of the proposed Phase I work is 2. The anticipated results of Phase I include a prototype design as well as experimental data supporting the feasibility of the concept, bringing the TRL to 3. Phase II will result in a completed prototype that will be used to validate predictions of key parameters, bringing the TRL to 4.

## Primary U.S. Work Locations and Key Partners



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Phase I

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Organizations Performing Work	Role	Type	Location
Astrobotic Technology, Inc.	Lead Organization	Industry	Pittsburgh, Pennsylvania
● Kennedy Space Center(KSC)	Supporting Organization	NASA Center	Kennedy Space Center, Florida

Primary U.S. Work Locations	
Florida	Pennsylvania

## Project Transitions

**January 2010:** Project Start**July 2010:** Closed out**Closeout Documentation:**

- Final Summary Chart(<https://techport.nasa.gov/file/140106>)

## Organizational Responsibility

**Responsible Mission Directorate:**

Space Technology Mission Directorate (STMD)

**Lead Organization:**

Astrobotic Technology, Inc.

**Responsible Program:**

Small Business Innovation Research/Small Business Tech Transfer

## Project Management

**Program Director:**

Jason L Kessler

**Program Manager:**

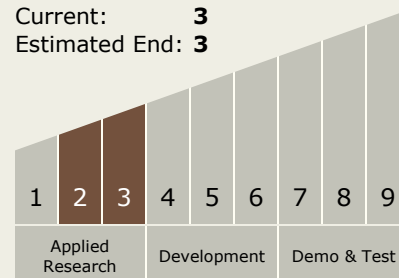
Carlos Torrez

**Principal Investigator:**

Alexander V Gutierrez

## Technology Maturity (TRL)

Start: 2  
 Current: 3  
 Estimated End: 3



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## Technology Areas

### Primary:

- TX04 Robotic Systems
  - └ TX04.3 Manipulation
    - └ TX04.3.2 Grappling Technologies

## Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System